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The association between stress related to information systems and the experience of workplace aggression among Finnish physicians

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Tiivistelmä - Referat - Abstract

Tavoitteet: Terveydenhuollon työntekijöiden epäasiallinen kohtelu on yleistä, minkä vuoksi on tärkeää tutkia siihen johtavia syitä. Aiemman tutkimustiedon perusteella tiedetään, että työkuormitus lisää epäasiallisen kohtelun todennäköisyyttä työympäristössä. Huonosti toimivat ja alati muuttuvat potilastietojärjestelmät muodostavat merkittävän kuormitusta aiheuttavan tekijän lääkäreillä. Tämän vuoksi tutkitaan, kokevatko lääkärit, jotka raportoivat enemmän tietojärjestelmäkuormitusta, myös enemmän epäasiallista kohtelua työpaikallaan.

Menetelmät: Tutkimuksen aineisto (n=3327) perustui Lääkärin työolot ja terveys 2019 -kyselyn poikittaisaineistoon. Epäasiallisen kohtelun osalta tutkittiin yleisesti minkä tahansa tyyppisen väkivallan, sekä erityisesti fyysisen tai henkisen väkivallan kohtaamista. Henkisen väkivallan osalta väkivalta jaettiin myös potilaiden ja omaisten, sekä kollegoiden ja esimiesten suunnalta tulevaan väkivaltaan. Väkivallan kohtaamisen todennäköisyyttä tarkasteltiin logistisella regressioanalyysillä käyttämällä tietojärjestelmäkuormitusmuuttujaa ennustavana tekijänä.

Tulokset ja johtopäätökset: Korkea tietojärjestelmäkuormitus oli yhteydessä kohonneeseen riskiin kokea niin fyysistä kuin henkistä väkivaltaa. Yhteys oli voimakkain henkisen väkivallan osalta. Tulokset osoittavat, että toimivien tietojärjestelmien suunnitteleminen on tärkeää lääkärien ja potilaiden hyvinvoinnin edistämiseksi. Aihe vaatii kuitenkin lisätutkimusta, etenkin tietojärjestelmästressin ja epäasiallisen kohtelun yhteyttä välittävien tekijöiden osalta.

Avainsanat – Nyckelord

väkivalta, tietojärjestelmäkuormitus, työhyvinvointi, työkuormitus, lääkärit

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Aims: Healthcare workers commonly suffer from workplace aggression, so it is important to understand factors that may increase its risk. Previous studies have shown that job demands increase the risk of inappropriate treatment at workplace. Furthermore, poorly functioning, and constantly changing information systems form a major work stressor for doctors. Therefore, the current study examines if physicians that report higher levels of stress related to information systems are also more likely to report experiencing workplace aggression.

Methods: The sample for the study (n=3327) was collected in the cross-sectional Finnish Physicians' Working Conditions and Health 2019 -study. Both physical and non-physical aggression were measured, and a combined variable for general aggression was also formed from them. For non-physical aggression, also the perpetrator of aggression was examined: patients or their relatives, and co-workers or superiors. For each type of aggression, logistic regression analysis was used with stress related to information systems as the predictive variable.

Results and conclusions: Higher levels of stress related to information systems were associated with higher likelihood of aggression in all types of aggression. The association was strongest with non-physical aggression. These results emphasize the importance of designing functional information systems to improve both the wellbeing of physicians and the quality of patient care in the future. However, the current findings warrant more research, especially regarding the possible mediating factors between stress related to information systems and workplace aggression.

Keywords

aggression, violence, information systems, SRIS, job demand, job strain, physicians

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Contents

1 Introduction

Workplace aggression against healthcare employees is a universal and concerning occurrence (Camerino et al., 2008; Cooper & Swanson, 2002; Lanctôt & Guay, 2014; Liu et al., 2019; Magnavita, 2014; Mento et al., 2020; Phillips, 2016; Raveel & Schoenmakers, 2019). Whether aggression manifests as physical or non-physical, it has serious negative implications for the wellbeing of healthcare workers (Cooper & Swanson, 2002; Lanctôt & Guay, 2014; Magnavita, 2014; Magnavita & Pastores, 2013), as well as for patient care (Cooper & Swanson, 2002; Lanctôt & Guay, 2014). Because workplace aggression has serious consequences, it is important to understand factors that may increase its risk.

Work stress is recognized as one of the factors that might increase the risk of workplace aggression (Camerino et al., 2008; Cole, Grubb, Sauter, & Swanson, 1997; Cooper & Swanson, 2002; Magnavita, 2014; Raveel & Schoenmakers, 2019). Rapid digitalization of healthcare has brought forth one major stressful work characteristic for healthcare workers, namely constantly changing, difficult, and poorly functioning information systems (Friedberg et al., 2014; Heponiemi et al., 2018, 2019; Linzer et al., 2016; Melnick et al., 2020; Shanafelt et al., 2016). Consequently, stress related to information systems (later denoted SRIS) has been recognized as one of the major work stress factors for healthcare professionals (Elovainio, Virtanen, & Oksanen, 2017; Linzer et al., 2002; Patel, Bachu, Adikey, Malik, & Shah, 2018; Väyrynen, 2020; Wallace, Lemaire, & Ghali, 2009). However, it has not been investigated if SRIS is associated with the experience of workplace aggression. The current study examines the association between SRIS and workplace aggression among Finnish physicians.

1.1 Workplace aggression in healthcare

Workplace aggression is a broad term that can encompass many different types of mistreatment at work. Aggression can be physical or non-physical in nature and it can manifest for example as verbal abuse, physical assaults, harassment, bullying, intimidation, threatening, and obscene behaviors (Camerino et al., 2008). Consequently, there is an abundance of proposed constructs of workplace aggression seeking to define the phenomenon (e.g. abusive supervision, bullying, incivility, social undermining, interpersonal conflict, emotional abuse, violence). However, many of these constructs lack in definition, as they show considerable overlap and do not have uniform attributes

(Hershcovis, 2011). Therefore, the definition of "workplace aggression" in this thesis will encompass simply all these manifestations and behaviors towards employees that can result in psychological, social or physical harm to the victim, as suggested in previous literature (Hershcovis, 2011).

Workplace aggression is a common and troubling occurrence within healthcare (Camerino et al., 2008; Cooper & Swanson, 2002; Hopkins, Fetherston, & Morrison, 2018; Lanctôt & Guay, 2014; Liu et al., 2019; Magnavita, 2014; Mento et al., 2020; Phillips, 2016; Raveel & Schoenmakers, 2019). Healthcare workers have been found to have a heightened risk of experiencing workplace aggression compared to other service workers (Cooper & Swanson, 2002), with estimated one tenth to two thirds of healthcare workers having encountered aggression, depending on country, definition of construct, and method of measurement (Camerino et al., 2008; Cooper & Swanson, 2002; Liu et al., 2019; Magnavita, 2014). It is generally agreed that the nursing staff is at highest risk of experiencing aggression (Cooper & Swanson, 2002; Morrison, Lantos, & Levinson, 1998), but the problem is prevalent among physicians as well (Liu et al., 2019; Morrison et al., 1998; Phillips, 2016). The prevalence of workplace aggression is likely even higher than reported because the incidents tend to be underreported (Liu et al., 2019; Phillips, 2016; Raveel & Schoenmakers, 2019). This presents an alarming picture of the state of experiencing workplace aggression in healthcare.

A widely used model by California Occupational Safety and Health Administration (1995) distinguishes between different types of workplace aggression by dividing it into three categories: *Type I,* where the assailant has no legitimate relationship to the workplace (e.g. robbery); *Type II,* where the assailant is a person who is either the recipient or the object of a service provided by the victim or workplace; and *Type III,* where the assailant is another employee, a supervisor or an acquaintance of the worker. In healthcare environments, violence arises typically from patient interactions (Type II), but much of the non-physical violence experienced in the healthcare workplace is perpetrated by colleagues and superiors as well (Type III) (Camerino et al., 2008; Cooper & Swanson, 2002; Liu et al., 2019; Magnavita, 2014; Morrison et al., 1998; Zampieron, Galeazzo, Turra, & Buja, 2010). However, studies examining workplace aggression have focused mostly on the aggression carried out by patients.

Workplace aggression has consequences for both the well-being of healthcare professionals and quality of patient care. Previous studies on healthcare workers show that experiencing workplace aggression is associated with negative psychological outcomes for the healthcare worker (e.g. stress, burnout, anxiety, depression), regardless of whether aggression is physical or non-physical (Cooper & Swanson, 2002; Lanctôt & Guay, 2014; Magnavita, 2014; Magnavita & Pastores, 2013; Mento et al., 2020). Importantly, instances of workplace aggression have also been associated with worse quality of patient care (Cooper & Swanson, 2002; Lanctôt & Guay, 2014). Namely, physician burnout and stress can affect both work productivity and efficiency (Wallace et al., 2009), and burnout is associated with higher number of errors (L. H. Hall, Johnson, Watt, Tsipa, & O'connor, 2016; Patel et al., 2018; Wallace et al., 2009). There is also evidence that physicians may deliver worse care if they are afraid of patients (Cooper & Swanson, 2002; Raveel & Schoenmakers, 2019), and being a victim of aggression can change the way a healthcare worker feels and behaves around a patient (Lanctôt & Guay, 2014). Finally, workplace aggression may also have organizational consequences, as workplace aggression is associated with absences from work (Lanctôt & Guay, 2014; Phillips, 2016) and the stress resulting from encountering aggression can cause some physicians to leave the organization altogether (Patel et al., 2018; West, Dyrbye, & Shanafelt, 2018).

In previous literature several victim, patient, and work environment characteristics have been associated with heightened risk of workplace aggression. Firstly, there is evidence that the gender of the victim might increase the risk of workplace aggression (Camerino et al., 2008; Cooper & Swanson, 2002; Liu et al., 2019; Mento et al., 2020; Zampieron et al., 2010), although contradictory evidence exists as well (Magnavita, 2014; Morrison et al., 1998; Raveel & Schoenmakers, 2019). Similarly, there is contradictory evidence on whether young age predisposes to experiencing aggression. Findings from several studies have supported this (Camerino et al., 2008; Liu et al., 2019; Morrison et al., 1998; Raveel & Schoenmakers, 2019), but that has not been the case in all studies (Zampieron et al., 2010). There is consistent evidence that patient characteristics (e.g. drug-use and mental illness) can increase the risk of aggression (Cooper & Swanson, 2002; Phillips, 2016; Raveel & Schoenmakers, 2019). Moreover, several environmental characteristics appear to increase the risk of aggression perpetrated by patients. These characteristics include but are not limited to uncomfortable surroundings, poor security,

accessibility to dangerous objects, and stressful work environment (Cooper & Swanson, 2002; Phillips, 2016; Raveel & Schoenmakers, 2019). Indeed, stressful workplace characteristics have been associated with a higher risk of not only aggression by patients, but also aggression perpetrated by superiors and colleagues as well (Camerino et al., 2008; Cole et al., 1997; Cooper & Swanson, 2002; Magnavita, 2014; Raveel & Schoenmakers, 2019). Given the prominent nature of stressful workplace characteristics in increasing the risk of workplace aggression, it is important to further understand these characteristics. Work-related stress in healthcare and the factors underlying it are discussed next.

1.2 Work-related stress in healthcare

Work stress is a term that refers to the process of work-related stimuli (also called job stressors) leading to negative physical, behavioral, or psychological consequences (e.g. strains) that can affect the health and wellbeing of an employee (Glazer, Liu, Glazer, & Liu, 2017). Work-related stress of healthcare professionals is a prevalent phenomenon linked with negative outcomes for physician's wellbeing and patient care quality (Cooper & Swanson, 2002; Patel et al., 2018; Wallace et al., 2009; West et al., 2018). Healthcare workers report higher levels of work-related fatigue than general population, with highest levels being reported by physicians (Hardy, Shapiro, & Borrill, 1997; Wallace et al., 2009). A half of physicians report burnout symptoms (Patel et al., 2018; Väyrynen, 2020; West et al., 2018) and studies suggest that these symptoms are becoming increasingly common (Grover, Adarsh, Naskar, & Varadharajan, 2018). What is more, physician's stress has a negative effect on workplace productivity, efficiency, patient care, and patient safety (L. H. Hall et al., 2016; Wallace et al., 2009; West et al., 2018).

1.2.1 Stressful work characteristics for physicians

Several theoretical models of a stressful work environment have been examined in the literature. The most prominent models are the job strain model (Karasek, 1979), the Job Demands-Resources model (JD-R model, Demerouti et al., 2001) and the Effort-Reward Imbalance model (ERI-model, Siegrist, 1996). In the job strain model, the combination of high job demand and low decision latitude (job control and skill use) causes higher levels of experienced mental strain at work, whereas the JD-R model sees that high job demands combined with low job resources is a risk factor for stress. Job demands can encompass all those physical, psychological, social, or organizational factors

in work that demand physical, cognitive, or emotional sustained effort and relate to psychological or physical costs (Bakker & Demerouti, 2007). According to ERI model stress arises from the imbalance of investing high effort but receiving low reward at work. Investing high effort can be seen as working hard to fulfill job demands. Importantly, all of these models highlight the role of high job demands in causing stress. According to current knowledge, high demands alone are associated with adverse health-related outcomes, such as increased stress (Bakker & Demerouti, 2014; Harvey et al., 2017; van der Molen, Nieuwenhuijsen, W Frings-Dresen, & de Groene, 2020).

Many types of job demands have been associated with physician-experienced stress. Commonly reported stress-related factors for physicians include excessive workloads, restricted autonomy, time pressure, conflicts at workplace, difficult patients and stress related to information systems (SRIS) (Elovainio et al., 2017; Grover et al., 2018; Linzer et al., 2002; Patel et al., 2018; Wallace et al., 2009; West et al., 2018). Physicians at healthcare centers and hospitals report that the most stressful work characteristics are time pressure, interpersonal conflicts and SRIS (Heponiemi, Aalto, & Elovainio, 2012). Despite becoming increasingly prevalent (Heponiemi et al., 2017), SRIS remains underrepresented in the literature regarding these most stressful work characteristics. Therefore, the role of SRIS as a stressor will be discussed next.

1.2.2 Information systems and their role as a stressor

Information systems (IS) refer to technological systems that manage healthcare data. They were created to improve the quality and safety of patient care and to streamline and assist healthcare professionals in helping patients. A common example of IS are electronic health records, which can be used for storing, sharing, searching and retrieving digital patient information, including pictures and documents in addition to text (Black et al., 2011). In theory, IS can offer improvements in quality of care and access to patient information remotely (Black et al., 2011; Friedberg et al., 2014; White & Danis, 2013), but it is still debated whether IS actually hinders physicians' job more than it helps it (Black et al., 2011; Holden, 2010; Hyppönen, Winblad, Reinikainen, Angeria, & Hirvasniem, 2010; Poissant, Pereira, Tamblyn, & Kawasumi, 2005).

IS are among the most highly regulated forms of technology and they have a wide userbase, which creates unique problems in terms of system development and usability. In addition to physicians, possible end-users of IS include e.g. administrators, nurses and even patients (Black et al., 2011), which makes it difficult to anticipate possible user

needs and thus, design functional IS. Although involving the end-users in the product development of IS is considered essential for its usability (Longhurst, 2014), physicians get rarely properly included in the production process of IS (Cresswell et al., 2011).

Consequently, IS respond poorly to the needs of physicians, thus accumulating masses of criticism and contributing to poor well-being. To give an example, a third of Finnish physicians recently reported constant complaints and distress over badly functioning IS (Väyrynen, 2020), building on a trend since 2010 (Kaipio, Hyppönen, & Lääveri, 2019). In Canada, three fourths of physicians suffering from burnout reported IS as a contributor to their burnout (Tajirian et al., 2020). Similar results have been observed consistently in the US as well (Gardner et al., 2019; Melnick et al., 2020; Shanafelt et al., 2016). Most notably, in a recent US study IS received a poor usability score way below the usability of many everyday technologies (Melnick et al., 2020). Indeed, physicians' complaints regarding IS often include aspects related to poor functionality and usability: difficult access to patient information, time-consuming and complex data entry, interference with patient care, inefficient and less-fulfilling work content, poor exchangeability of data between different systems, and degradation of clinical documentation (Aalto & Pajuriutta, 2020; Friedberg et al., 2014; Heponiemi et al., 2017; Kroth et al., 2019; Shanafelt et al., 2016; Tajirian et al., 2020; Vänskä et al., 2010). Moreover, there are several IS-related factors that have been directly associated with distress, stress and burnout, such as technical problems, higher number of systems in daily use, information overload, slow system response times, excessive data entry, slowness of navigation, interference with patient-physician-relationship, fear of missing something, and notes geared towards billing (Heponiemi et al., 2019; Kroth et al., 2019).

Problems tend to accumulate, and coping with poorly functioning or difficult-to-use IS is especially taxing if there are other stressful work factors, such as time pressure (Heponiemi et al., 2017, 2018). Despite the intended use as providing support to physicians, IS is often associated with increased time pressure, because trying to cope and deal with difficult-to-use IS and possible technical problems takes time (Heponiemi et al., 2018; Vainiomäki et al., 2017). To further complicate the issue, frequently changing systems require physicians to continuously update their knowledge on IS, and learning to use IS requires time and training (Tajirian et al., 2020; Vänskä et al., 2014), which further increases the time pressure and strain of physicians.

These facts show that despite the intended use of IS as a tool to assist and streamline patient care, the current state of IS responds poorly to the needs of physicians and seems to be a significant job stress-causing factor for them. Indeed, the usage of IS has been associated with higher rates of physician's burnout (Robertson, Robinson, & Reid, 2017; Shanafelt et al., 2016). Moreover, the stress related to IS appears to be increasing and IS are considered an especially stressful work-related factor in the public healthcare sector (Heponiemi et al., 2012).

SRIS can hinder the work of physicians and consequently have detrimental repercussions to the quality of patient care. In general, the implementation of IS seems to have moved much of the clerical work (e.g. order entry and dictation) to physicians (Shanafelt et al., 2016), which gets in the way of their actual work - helping the patients. Moreover, there is a concern that the usage of IS interferes with the relationship between the physician and the patient (Black et al., 2011). Indeed, there is evidence that the computer screens become a literal barrier between physicians and their patients, as physicians spend less time looking at the patient when reading the patient records in IS rather than reading the information on paper, although there is variation between physicians, their style, and their competency in using IS (Asan, D. Smith, & Montague, 2014). The apprehension about IS interfering with patient interaction appears to be widespread, but there is contrary commentary as well: even though this apparent drop in attention might feel off-putting to some patients, it has been suggested that thorough/meticulous inputting of information can also signal to the patient that they are being heard (Asan & Montague, 2012).

Overall, it seems that IS do not only fail to work as a resource to help with existing job demands (e.g. time pressure), but at its worst, IS can function as a demand itself. Combined with the fact that physicians are not engaged with designing of IS, and therefore lack control over their work and equipment on which they spend a great proportion of their work time, this means that SRIS is a significant stressful work-related factor for physicians.

1.3 Workplace aggression and stress related to information systems

As stated earlier, stressful work characteristics have been associated with a higher risk of being a victim of aggression. In general, job stress has a negative impact on social relationships, which might lead to interpersonal conflict and aggression (Johnson &

Indvik, 2001). For example, emotional exhaustion, a common consequence of stress (van den Tooren & de Jonge, 2008), can lead to depersonalization, and subsequently, to negative behavioral changes toward patients and colleagues (Winstanley & Whittington, 2010). It has been suggested that these changes in attitudes and behavior might predispose healthcare workers to aggression (Winstanley & Whittington, 2010). The association between stress and aggression has been explored previously in several theories, which will be discussed next.

Theories of aggression explain why stress, including SRIS, might be associated with workplace aggression. Firstly, according to the cognitive-neoassociation model (Berkowitz, 1989), aversive events and circumstances arouse negative affect (i.e. negative feelings), which may create aggressive inclinations. Aggressive inclinations in turn may lead to aggressive behavior (Berkowitz, 1989). Aversive events can include, for example, frustrations, which are events (rather than emotional experiences) that arise when the attainment of goals is interrupted or blocked (Dollard, Miller, Doob, Mowrer, & Sears, 1939).

SRIS is likely to arouse frustration and negative affect, which makes it a risk factor for aggression. As illustrated before, changing, difficult, and poorly functioning IS form an especially frustrative and stressful work-related factor for physicians: it hinders their work, creates additional time-pressure and interferes with patient interaction. Most importantly, SRIS is consistently associated with the distress and poor wellbeing of physicians (Gardner et al., 2019; Kroth et al., 2019; Kuusio, Heponiemi, Aalto, Sinervo, & Elovainio, 2012; Melnick et al., 2020; Shanafelt et al., 2016; Tajirian et al., 2020; Väyrynen, 2020), demonstrating the connection between SRIS and negative affect. If SRIS is prevalent within the workplace, this SRIS-related negative affect may lead to aggressive behavior between physicians (Type III aggression). Similarly, inconveniences caused by IS may also create frustration and negative affect in patients and their relatives, and thus increase the risk of Type II aggression.

Secondly, theories of social learning and emotional contagion could provide an additional explanation for aggressive behavior. According to social learning theories (Bandura, 1983) people acquire aggressive behaviors by observing others. Hence, the aggressive behavior of a stressed physician might get modeled by patients, relatives, or other healthcare workers. Moreover, the negative affect of a physician might influence the mood of patients, relatives, and staff, a phenomenon explained by the emotional

contagion theory (Hatfield, Cacioppo, & Rapson, 1993). This means that the negative affect of a physician might arouse negative affect in others. Indeed, it has been found that the mood of a healthcare worker is associated with the mood of patients (Haas et al., 2000; J. A. Hall, Roter, & Katz, 1988) and other healthcare workers (Chang, Teng, Chu, Chang, & Hsu, 2012; Petitta, Jiang, & Härtel, 2017).

Finally, the usage of IS has become an increasingly common and crucial part of a physician's work, which means that it forms a constant source of negative affect and frustration. According to excitation transfer theory (Zillmann, 1971), high arousal (such as anger) from an event dissipates slowly, and the lingering arousal can increase the arousal in the next situation. This means that although one event of SRIS might not lead to aggressive behavior, aversive events and negative affect caused by IS can add up, until a critical threshold is reached leading to acts of aggression. This phenomenon does not concern only the physician, but can be applied to the experiences of patients, relatives, and other healthcare staff as well.

To conclude, IS forms a major stressful work factor for physicians, and can cause frustration and negative affect by hindering their work and hence, patient's and staff's goals. In addition, the stress caused by IS can be reflected in the mood of a physician, and this negative mood may transfer to patients, relatives, and staff through a process of emotional contagion. Eventually, this negative affect related to IS can lead to aggressive inclinations and aggressive behavior. However, the aggressive behavior of a physician may also be learned and modeled by patients, relatives, and staff. Also considering the facts that the healthcare environment is prone to aversive events and negative affect in general and that the high arousal of aversive situations may linger and accumulate, SRIS forms a notable risk for aggression.

1.4 The current study

Because workplace aggression is a major concern both for the wellbeing of physicians and quality of patient care, it is critical to understand risk factors that may increase its occurrence. Previous research has shown that stressful work characteristics increase the risk of workplace aggression, potentially by inducing frustration and negative affect. Changing, difficult, and poorly functioning information systems have been consistently recognized as a major stressful work characteristic for physicians. However, no studies have examined the association between SRIS and workplace aggression. Furthermore,

previous research on workplace aggression has examined mainly aggression from patients, although much of the aggression is perpetrated by healthcare staff. Therefore, the current study examined the association between SRIS and workplace aggression perpetrated both by patients and healthcare staff among physicians. The forms of workplace aggression examined in this study include both non-physical and physical aggression, since both types of aggression have been commonly studied in previous research (Liu et al., 2019).

This study aims to answer the following main study question:
Are physicians who experience higher levels of SRIS more likely to encounter workplace aggression?
Based on the main study question, following questions were formed:
1. Is SRIS associated with non-physical and physical aggression?
2. Is SRIS associated with non-physical aggression perpetrated both by patients and relatives (Type II), and co-workers and superiors (Type III)?

2 Methods

2.1 Participants and procedure

Data for this study were drawn from the cross-sectional Finnish Physicians' Working Conditions and Health 2019 -study, which is the fourth in a series of surveys conducted in 2006, 2010 and 2015. The study aims to improve the workplace wellbeing of Finnish physicians by inspecting the working conditions, job strain, satisfaction, engagement, and experiences of discrimination in work.

Participants were sampled randomly from the registry of the Finnish Medical Association, which covers almost all of the Finnish physician population. Those participants that gave their consent to be included in any further studies in the 2006 study were also included in 2019. The participants asked to partake in current study (n=8374) were approached via email or letter if email was unavailable. A total of 4448 physicians completed the questionnaire. Out of these, only those who were currently employed were included in the study (n=3522) in order to capture the current state of SRIS and work aggression. To enable comparable analyses, those who had incomplete demographic information (age, sex or working sector) were removed, which resulted in a final analytic sample of 3472 (67.6% of whom were women), representing 41.5% of the original selection.

2.2 Measures

2.2.1 Workplace aggression

Experiences of both non-physical and physical workplace aggression were measured.

Non-physical workplace aggression was assessed with the following question: *"Non-physical violence is defined by ongoing, repeating bullying, oppression or offensive behavior. Do you experience or have you experienced non-physical violence or bullying in your work during the last 12 months?".* If a participant answered positively, the origin or perpetrator of aggression was also inquired and the participant could choose any number of the four provided options: coworkers, patients, patient's relatives, and supervisors. From these answers, three dichotomous variables for non-physical aggression were formed: non-physical aggression from any source (1=yes; 0=no); non-physical aggression from co-workers or superiors (1=yes; 0=no); and non-physical aggression from patients or their relatives (1=yes; 0=no). There were 135 physicians who reported that they had not experienced non-physical aggression, but still reported a specific source of non-physical aggression. These answers were re-coded as "has experienced non-physical aggression."

Physical workplace aggression was assessed with the following question: *"Have you been exposed or threatened with physical violence during the last 12 months?".* Participants could choose from three options: *"No"* (1), *"I've only been threatened"* (2), *"I've also been exposed to violence"* (3). A dichotomous variable for physical aggression was formed (1=yes (options 2 and 3, at least threatened with violence); 0=no).

A variable for experiencing any type of aggression was formed based on variables of non-physical and physical aggression (1=yes (has experienced either non-physical aggression, physical aggression, or both), 0=no).

2.2.2 Stress related to information systems (SRIS)

SRIS was assessed with the following question: *"How often (during the past half-year period) have you been distracted by, worried about, or stressed about"* with respect to following items: i) "*constantly changing information systems"* and ii) *"difficult, poorly functioning IT equipment/ software".* Participants were asked to estimate the level of frequency with a Likert scale from 1 (Very often or constantly) to *5* (Very rarely or never). The scale was inverted for the analysis and a mean score from the items was formed to reflect the level of stress caused by IS. The variable's reliability was good

(Chronbach's alpha = 0.76) in the present sample. Although SRIS is a mean of only two items rather than that of several, SRIS has been previously used in similar studies where it showed good reliability (0.84—0.87) (Heponiemi et al., 2017).

2.2.3 Covariates

All analyses were adjusted for gender (1=male, 2=female), age (linear term), and work sector (1=public, 2=private), because demographic factors have been associated with a risk of aggression in some previous studies (Camerino et al., 2008; Cooper & Swanson, 2002; Kuusio et al., 2012; Liu et al., 2019; Mento et al., 2020; Morrison et al., 1998; Phillips, 2016; Raveel & Schoenmakers, 2019; Zampieron et al., 2010).

2.3 Statistical analyses

2.3.1 Analysis of missing data

Missing data was analyzed by comparing complete cases (n=3327) and those with missing values in variables (n=145) with t-test and χ^2-test. The cases with any missing values were coded as 1 and those cases with no missing values were coded as 0. The analysis revealed that 4.2% of cases had missing values related to study variables. Physical aggression had most missing values (3.6%), whereas non-physical aggression and SRIS had both less than 1% of values missing. As shown in table 1, compared to cases with complete data, cases with missing data were significantly less likely to experience physical aggression ($\chi^2(1)=229.58$, $p< .001$), non-physical aggression by patients or relatives ($\chi^2(1)=4.62$, $p= .03$), and non-physical aggression by co-workers and superiors ($\chi^2(1)=8.18$, $p= .004$). However, most of the missing values attributed to aggression variables, so observed differences in the aggression variables may have originated from small group size (e.g. in missing group there were only 20 values in physical aggression and 125 values in non-physical). Cases with missing data were also significantly older than cases with complete data ($t(3470) =-2.50$, $p= .01$), but the average ages between missing (mean=48.9) and complete (mean=46.6) cases were quite close to each other and visual examination on the distributions did not reveal noticeable differences between the groups. Therefore, the difference between complete and missing cases was considered small and missing values were not observed to behave systematically. Based on the relatively low number of missing cases and the analysis on group means, omitting missing cases from the study was deemed appropriate while still retaining a sufficient sample size (n=3327).

Table 1. *The results of missing values analysis with χ2-test and t-test, wherein the complete cases (n=3327) were compared to cases with mising values (n=145)*

Variable	χ^2	df	p	Variable	t	df	p
Gender[a]	0.08	1	.78	Age	-2.50	3470	**.01**
Work sector[b]	1.50	1	.22	SRIS[e]	0.14	3452	.89
Physical aggression[c]	229.58	1	**<.001**				
Non-physical aggression[d]	0.50	1	.48				
Patients or relatives[d]	4.62	1	**.03**				
Co-workers or superiors[d]	8.18	1	**.004**				

[a]Gender 0=male, 1=female

[b]Work sector 1=public, 2=private

[c]Physical agression 0=no, 1=at least threatened

[d]Non-physical agression 0=no, 1=yes

[e]Stress related to information systems (1-5), 1=low, 5=high

2.3.2 Analysis of the study variables

The bivariate association between study variables was first studied with Pearson correlation for continuous variables. The differences in SRIS, age, gender, and work sector between those who reported experiencing a type of aggression were analyzed with t-test and χ^2-test. Then logistic regression analysis was used to determine how SRIS was associated with the likelihood of experiencing different types of aggression. The independent variable was the mean score for SRIS. Dependent variables included any type of aggression, physical aggression, non-physical aggression, non-physical aggression perpetrated by patients or relatives, and non-physical aggression perpetrated by co-workers or superiors. Each of the aggression types were examined separately in their own models. The models were also adjusted for demographic variables (gender, age, and work sector). The results for logistic regression were reported with Odds ratios (OR) and their 95% confidence intervals (CI). The reported Odds ratio depicts the factor by which the odds of an outcome increase when the independent variable increases by 1 standard deviation. Therefore, the Odds ratio quantifies the strength of the association between variables.

3 Results

3.1 Characteristics of the study population

Characteristics of the included participants and descriptive statistics for the study variables are shown in the table 2. A fifth (22.4%) of the physicians had experienced some

type of workplace aggression within the last 12 months. Experiencing non-physical aggression was a little bit more common (13.6% of physicians) than physical aggression (12.3%), with 3.5% having experienced both. Experiencing non-physical aggression perpetrated by co-workers and superiors (Type III) was more common (9.4% of physicians) than non-physical aggression perpetrated by patients or relatives (Type II) (4.9%). 36 physicians (1.1%) reported experiencing aggression both from patients and relatives (Type II) and co-workers and superiors (Type III), and 11 physicians (0.3%) did not specify the perpetrator of non-physical aggression.

Table 2. *Variable means and standard deviations (sd) or frequences and percentiles (n=3327)*

Variable	**n**	**%**	**Variable**	**mean**	**sd**
Gender (females)	2246	67.5	Age (years)	46.6	11.03
Sector			SRIS	3.36	1.04
Public	2502	75.2			
Private	825	24.8			
Aggression (physical or non-physical)	746	22.4			
Physical aggression	410	12.3			
Non-physical aggression	452	13.6			
Patients or relatives	164	4.9			
Co-workers or superiors	313	9.4			

3.2 Bivariate associations

SRIS had a significant association with older age (r= .08, p< .001). Moreover, significantly higher levels of SRIS were reported by females (mean=3.40, difference=-0.12, t=-3.21, p< .001), and by those working in the public sector (mean=3.44) compared to those working in the private sector (mean=3.11, t=8.11, p< .001). The differences in SRIS and demographic variables between those who reported experiencing some type of aggression and those who did not are shown in the table 3. Those who reported experiencing any type of aggression reported significantly higher levels of SRIS. Those who reported experiencing any type of aggression or physical aggression were younger. Instead, those that reported experiencing non-physical aggression or non-physical aggression from co-workers or superiors were older. Those that experienced aggression were more commonly females in all types of aggression except in physical aggression. Similarly, those that experienced aggression worked more commonly in the public work sector in all types of aggression except non-physical aggression perpetrated by patients and relatives.

Table 3. *The differences in stress related to information systems (SRIS), age, gender and work sector between those that reported experiencing a certain type of aggression and those that did not (n=3327)*

	Aggression[a]				Physical aggression[b]				Non-physical aggression[c]				Non-physical aggression by patients or relatives[c]				Non-physical aggression by co-workers or superiors[c]			
	no	yes			no	yes			no	yes			no	yes			no	yes		
Variable	**mean**		**t**	**p**	**mean**		**t**	**p**	**mean**		**t**	**p**	**mean**		**t**	**p**	**mean**		**t**	**p**
SRIS[d]	3.32	3.51	-4.43	**<.001**	3.34	3.49	-2.66	**.008**	3.33	3.57	-4.69	**<.001**	3.35	3.53	-2.17	**.03**	3.34	3.59	-4.15	**<.001**
Age	47.0	45.4	3.37	**<.001**	47.1	43.0	7.21	**<.001**	46.4	47.7	-2.39	**.02**	46.7	45.6	1.23	.22	46.4	48.8	-4.12	**<.001**
Variable	**%**		**t**	**p**	**%**		**t**	**p**	**%**		**t**	**p**	**%**		**t**	**p**	**%**		**t**	**p**
Gender[e] (women)	65.8	73.3	14.49	**<.001**	67.2	69.5	0.76	.38	66.1	76.8	19.97	**<.001**	67.1	75.6	4.78	**.03**	66.4	78.6	18.81	**<.001**
Work sector[f] (public)	72.5	84.5	43.46	**<.001**	73.3	89.0	47.06	**<.001**	74.2	81.9	12.02	**<.001**	75.0	79.3	1.31	.25	74.5	82.4	9.25	**.002**

[a]Any type of aggression, physical or non-physical 0=no, 1=yes

[b]Physical agression 0=no, 1=at least threatened

[c]Non-physical agression 0=no, 1=yes

[d]Stress related to information systems (1-5), 1=low, 5=high

[e]Gender 0=male, 1=female

[f]Work sector 1=public, 2=private

3.3 The association between SRIS and aggression

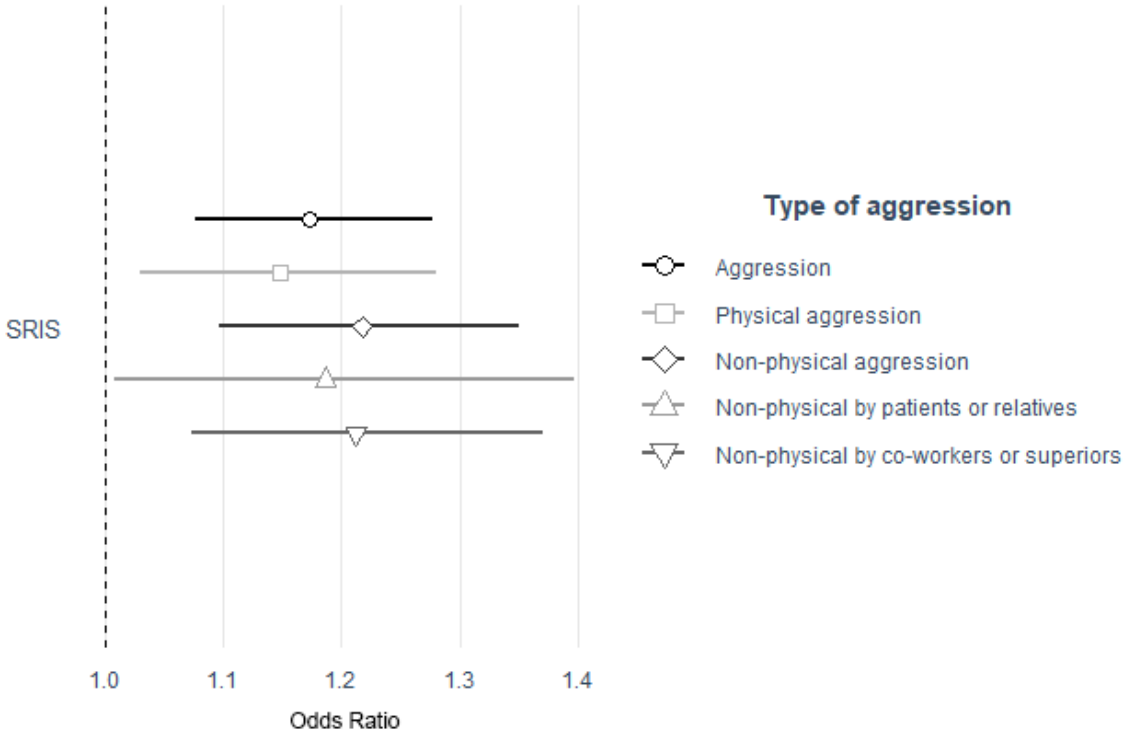

Figure 1. *Odds ratios and 95% confidence intervals for SRIS in increasing the likelihood of different types of aggression.*

Figure 1 shows the results of logistic regression analysis with Odds ratios for the associations of SRIS with the aggression variables. SRIS was significantly associated with increased probability for encountering aggression in all the aggression types ($p<.05$ in all the models). Out of the aggression variables, SRIS had the strongest association with non-physical aggression, especially when aggression was perpetrated by co-workers or superiors (figure 1). However, the confidence intervals for the Odds ratios overlapped considerably for all the aggression variables, suggesting that there was no significant difference between the aggression types. SRIS was associated with increased odds for experiencing any type of aggression (un-adjusted: OR 1.20, 95% CI 1.11 to 1.31; adjusted: OR 1.17, 95% CI 1.08 to 1.28), physical aggression (un-adjusted: OR 1.15, 95% CI 1.04 to 1.28; adjusted: OR 1.15, 95% CI 1.03 to 1.28) and non-physical aggression (un-adjusted: OR 1.27, 95% CI 1.15 to 1.41; adjusted: OR 1.22, 95% CI 1.10 to 1.35). For non-physical aggression, SRIS was associated with increased odds for experiencing aggression both by patients and relatives (un-adjusted: OR 1.19, 95% CI 1.02 to 1.40;

adjusted: OR 1.19, 95% CI 1.01 to 1.40) and by co-workers and superiors (un-adjusted: OR 1.29, 95% CI 1.14 to 1.45, adjusted: OR 1.21, 95% CI 1.07 to 1.37). Overall, the results of un-adjusted and adjusted models were quite similar. Model predicted probabilities for experiencing a specific type of aggression at different levels of SRIS are presented in Figure 2.

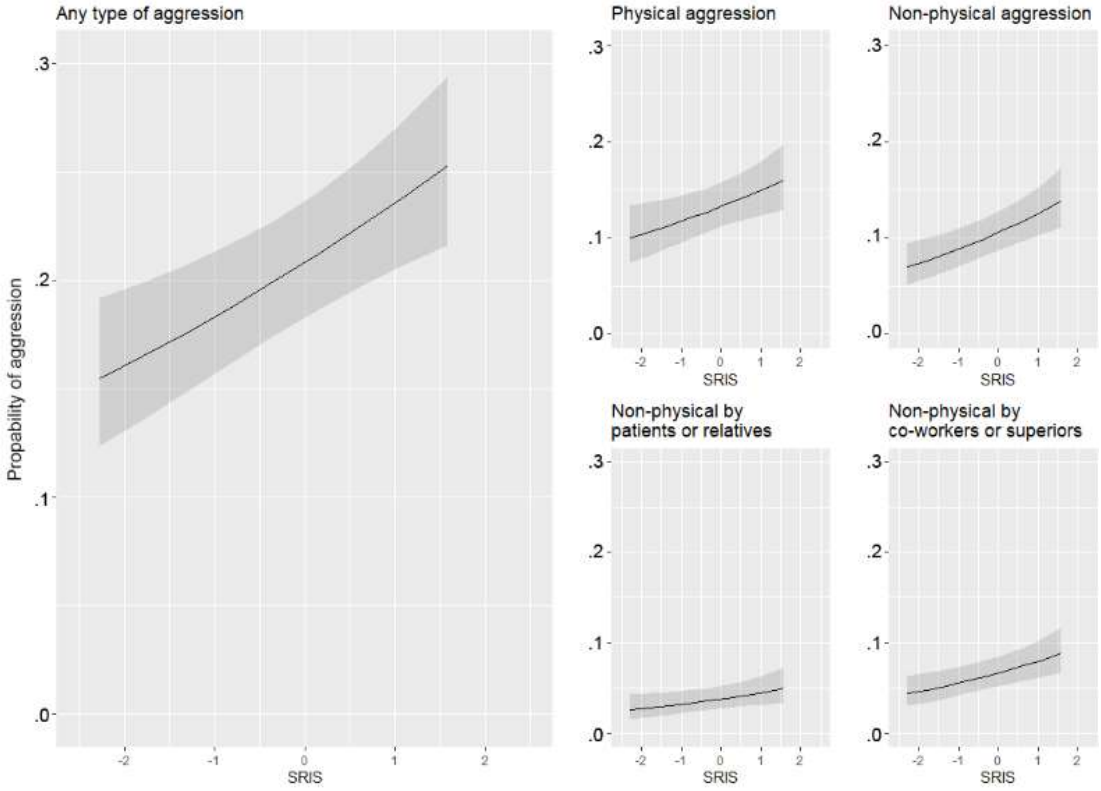

Figure 2. *Probabilities and 95% confidence intervals for experiencing a specific type of aggression predicted with the level of standardized SRIS. Predictions were derived from logistic regression analysis, adjusted for gender, age, and work sector.*

4 Discussion

This study investigated whether physicians who experience higher levels of stress related to changing, difficult, and poorly functioning healthcare information systems are more likely to encounter workplace aggression. Experiencing higher levels of SRIS was associated with higher likelihood of being subjected to all types of aggression, but the association was most pronounced with non-physical aggression. Poorly functioning and constantly changing information systems have previously been shown to form a stress-

ful work factor for physicians, and stressful work factors have been linked with increased risk of workplace aggression. However, this is the first study to inspect the association between SRIS and experiencing workplace aggression.

The first study question examined whether SRIS is associated with both non-physical and physical aggression. Higher levels of SRIS were linked with higher likelihood of experiencing aggression, regardless of the type of aggression. The result was in line with previous studies where stressful workplace characteristics have been associated with higher risk of experiencing aggression (Camerino et al., 2008; Cole et al., 1997; Cooper & Swanson, 2002; Magnavita, 2014; Raveel & Schoenmakers, 2019). The result was also supported by the aggression theories that offer possible explanations for the mechanisms behind the association between SRIS and aggression: namely frustration, negative affect, social contagion, and social learning, although these mechanisms could not be examined in the current study. To better understand the observed association, these mechanisms should be examined in future studies preferably in a longitudinal or qualitative setting.

The association between SRIS and aggression appeared to be most pronounced with non-physical aggression although the differences between different levels of aggression were not significant. This tentative result is consistent with a previous longitudinal study where stress-related variables were found to be better predictors of non-physical aggression than physical aggression (Magnavita, 2014). This association of SRIS with non-physical aggression could be explained by the fact that the stressed behavior likely includes more aspects from non-physical aggression (e.g. angry tone of voice) than physical manifestations. Therefore, as the stressed behavior is modeled by for example a patient (Bandura, 1983), the modeled behavior is also more likely to reflect aspects of non-physical aggression. Moreover, acts of physical aggression are perceived less morally acceptable than acts of non-physical aggression, which might make non-physical aggression a more likely response to SRIS overall.

The second study question asked whether SRIS is associated with non-physical aggression perpetrated both by patients and relatives (Type II), and co-workers and superiors (Type III). The association was observed with both types of aggression, with no observed difference between the perpetrator groups. Surprisingly, aggression by co-workers or superiors was found to be more prevalent than that by patients or their relatives. Previous studies have found the prevalence to be the other way around (Camerino et al.,

2008), although it is important to notice that studies concerning aggression perpetrated by superiors and co-workers is more scarce than that perpetrated by patients and relatives. These results accentuate the need to investigate workplace aggression perpetrated by other healthcare staff further as well.

The study found that a fifth of physicians reported having experienced aggression, which was less than in previous global review studies (Liu et al., 2019; Phillips, 2016). However, it is important to notice that there has been significant heterogeneity across previous studies, which makes it difficult to make direct comparisons. For example, differences in questionnaire wording and the definition of inspected timeframe (e.g. past 12 months vs. lifetime) could influence results. Nevertheless, it might be that the Finnish healthcare systems is unique in this regard, as the prevalence of aggression has been found to be equally low previously as well (the Finnish Medical Association, 2019).

The demographic factors did not have a noticeable influence on the association between SRIS and aggression. However, work-sector, gender, and age were significantly associated with aggression, in line with some of the previous literature. Those who experienced most types of aggression worked more commonly in the public work sector, which might reflect the differences in resources between the public and private sector. Female gender was more common in most types of aggression, supporting the bulk of the previous literature (e.g. Mento et al., 2020; Zampieron et al., 2010). However, similarly to previous results findings related to age were here somewhat contradictory: experiencing some types of aggression was more common among younger physicians and others among older physicians. Interestingly, those who reported experiencing non-physical aggression and aggression from co-workers and superiors were older than those who did not. This is likely explained by the association between SRIS and aggression, as higher levels of SRIS were linked to older age. It is possible that older physicians find it harder to learn new IS than their younger colleagues, which compounds the SRIS they feel, and thus leads to frustration, negative affect, and conflicts between the physician and other staff. However, previous results on age and SRIS have been mixed (Gardner et al., 2019; Shanafelt et al., 2016).

This study is subject to some limitations, which should be considered when interpretating the results. Firstly, it should be noted that causational direction between SRIS and aggression could not be determined as the current study used cross-sectional data. Perhaps higher levels of workplace aggression predict higher levels of SRIS. It might be

that aggression adds to work strain (Magnavita, 2014) and work strain increases cognitive workload, which in turn evokes SRIS (Heponiemi et al., 2012). Indeed, there is reason to presume the causational effect might be bi-directional, since aggression has been found to both predict and follow job strain (Magnavita, 2014). SRIS might increase workplace aggression by increasing negative affect in the physician and those around them. Consecutively, experiencing workplace aggression might increase the cognitive workload of a physician, which would again increase the likelihood of feeling stressed over poorly functioning and changing IS.

Secondly, there were limitations related to the study variables. The variables were assessed on an individual level, which meant that the effects of the department or organization could not be examined. The same IS are presumably used across the workplace, so individual reports of SRIS could therefore reflect a problem on a department or organizational level. In addition, using self-report measures might have introduced common-methods variance in the results. Since workplace aggression was measured with subjective reports rather than objective measures, it is also possible that stress might influence a physician to perceive the behavior of others as aggressive. Indeed, according to the mood-congruity theories (Schwartz, 1990), negative mood might make an individual to perceive others in a negative way. To study this possibility, objective measurements of workplace aggression with controls for the effects of mood-congruity should be used in the future. However, previous studies of workplace aggression have used questionnaires and surveys to study workplace aggression (Liu et al., 2019; Mento et al., 2020), so a self-report measure of workplace aggression was deemed appropriate for the current study as well. In addition, the SRIS variable was measured as a mean of only two items, rather than that of many. However, SRIS showed good reliability in the current study and in previous studies (Heponiemi et al., 2017). Furthermore, higher levels of this measure of SRIS have been previously associated with variables reflecting problems with IS (e.g. higher level of technical problems and low levels in user-friendliness) (Heponiemi et al., 2019) and psychological distress (Kuusio et al., 2012). Therefore, this measure of SRIS could be considered an adequate measure of experienced stress related to information systems.

Moreover, the observed associations were statistically weak, which reflects the fact that reasons underlying instances of aggression are complex and encompass numerous other factors that could not be examined in the current study. Some of these factors could be

unique to Finland, as the tax-financed healthcare system and the used IS are unique themselves, which might affect the generalizability of these results. However, IS have been consistently reported to cause stress for physicians and experiencing aggression is a prevalent problem in other countries as well, which encourages similar studies to be conducted in other countries. Lastly, the current study was conducted with physicians, so the results should be applied to other healthcare professionals with caution.

To conclude, the current study provides evidence that higher levels of SRIS are associated with higher likelihood of experiencing aggression at workplace. Because SRIS may increase the risk to experiencing aggression, it is possible that IS also endangers the wellbeing of physicians and the quality of patient care. The present results align with previous literature on the potential negative effects of SRIS. This notion has decisive implications for the future development of IS, especially since over a third of physicians in our study reported suffering from SRIS frequently or more often, in line with previous literature (Gardner et al., 2019; Kaipio et al., 2019; Melnick et al., 2020; Tajirian et al., 2020). Improvements to both the wellbeing of physicians and the quality of patient care could be gained in the future by including proper usability design and active participation of physicians in the development of IS. Special care should be taken in ensuring that future IS functions more as a resource than a demand. Moreover, resourcing additional time and training for physicians during introduction of a new IS could also alleviate time pressure and thus stress related to managing new IS. However, the current findings warrant more research, especially regarding the possible mediating factors between SRIS and aggression. Collecting longitudinal information on the effect of SRIS on different types of aggression on organizational or department level with different profession groups could provide further insights in future research.

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